

# Relation Between Housing Age, Housing Value, and Childhood Blood Lead Levels in Children in Jefferson County, Ky

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Lead poisoning is the most common cause of environmental disease in children. Elevated blood lead levels are associated with lower IQs, impaired growth and neurological development, and behavior problems. Approximately 890 000 (4.4%) children younger than 6 years in the United States have blood lead levels of 10 µg/dL or greater.<sup>1</sup> Children who are Black, are poor, and live in older houses are at greatest risk.<sup>2</sup> The Centers for Disease Control and Prevention recommend screening based on housing age and zip code. Geographic information systems technology allows a more specific mapping of areas with older housing than do zip codes.<sup>3</sup> We refined this approach by linking socioeconomic data to tax assessor data to determine whether living in older or less-expensive housing is a risk factor for having an elevated blood lead level among children.

## METHODS

The Jefferson County Childhood Lead Poisoning Prevention Program lead-screening registry provided blood lead levels and addresses for Jefferson County children during 1991 through 2000. Errors such as improper spelling and invalid addresses and zip codes were corrected with data obtained from libraries maintained by the Louisville and Jefferson County Information Consortium. We omitted addresses not in Jefferson County or consisting only of a post office box or rural route.

Centrus Desktop software (Sagent Technology Inc, Mountain View, Calif) was used to geocode addresses. We used ArcView 3.2 software (Environmental Systems Research Institute, Redlands, Calif) to link geocoded addresses to the property valuation administrator's Real Estate Master File, a tax assessor database from the Louisville and Jefferson County Information Consortium that contains information on each house's year of construction, assessment value, and other historical data.

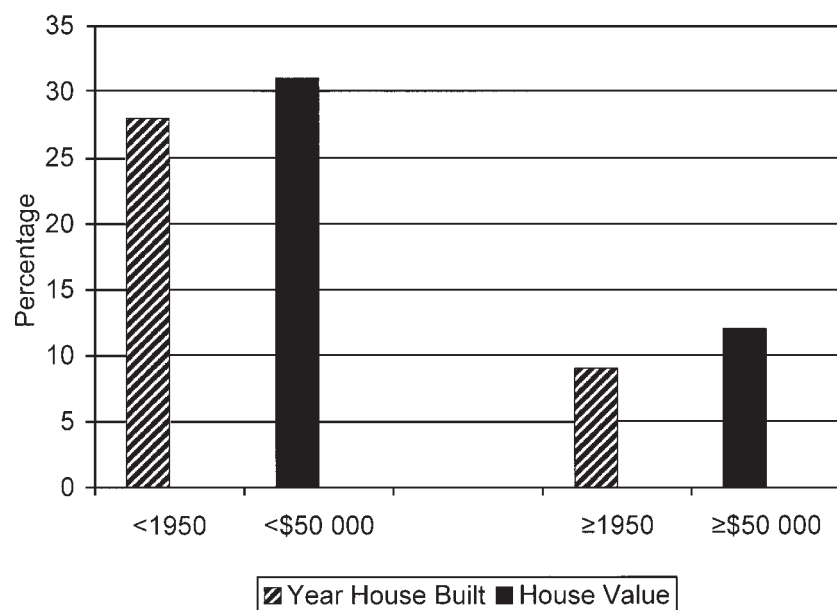
Housing built before 1900 was categorized as built in 1900. Housing coded as "pre-50" (before 1950) or "post-49" (1950 or later) was used only for analyses that stratified the houses as old or new rather than by decade. Houses worth less than \$50 000 were considered lesser valued, and those worth \$50 000 or more were higher valued. An elevated blood lead level was defined as 10 µg/dL or greater. We included children aged 12 to 71 months and used the first blood lead test. The relation among child blood lead levels, child age, housing value, and year of house construction was analyzed with SAS (SAS Institute Inc, Cary, NC).

## RESULTS

We geocoded addresses and obtained housing ages and values for 34 798 children. The mean blood lead level was 5.1 µg/dL and the median age was 35 months; the median year of house construction was 1945. Blood lead levels were elevated in 6240 (17.9%) children.

Children living in old houses had higher geometric mean blood lead levels than did children living in new houses (6.4 µg/dL vs 4.3 µg/dL,  $P < .001$ ). More children living in old housing had elevated blood lead levels (4406; 28%), compared with those living in new housing (1794; 9%) (odds ratio [OR] = 3.79; 95% confidence interval [CI] = 3.56, 4.02; Figure 1). From 1900 to 1980, the older the house, the higher the mean blood lead level of resident children and the greater the proportion of resident children with elevated blood lead levels (Table 1).

Elevated blood lead levels were found in 3431 of the 10 924 (31%) children living in lesser-valued housing, compared with 2809 of 23 874 (12%) children living in higher-valued housing (geometric mean



**FIGURE 1—Percentage of children with elevated blood lead levels, based on year house built and house value.**

**TABLE 1—Children's Blood Lead Levels, Stratified by Age of House (Decade of Construction)**

Decade of Construction	Elevated BLL, %	n	Mean BLL, $\mu\text{g}/\text{dL}$
1900s	40.5	5479	7.76
1910s	30.7	2031	6.79
1920s	26.6	2842	6.37
1930s	16.1	1065	4.89
1940s	11.6	2365	4.67
1950s	8.6	4427	4.14
1960s	7.2	2783	3.86
1970s	6.9	1907	3.69
1980s	7.1	477	3.42
1990s	11.2	724	4.15

Note. BLL = blood lead level.

blood lead levels = 6.8  $\mu\text{g}/\text{dL}$  vs 4.5  $\mu\text{g}/\text{dL}$ ; OR = 3.43; 95% CI = 3.24, 3.63; Figure 1). Housing value remained an independent risk factor for an elevated blood lead level (adjusted OR = 2.22; 95% CI = 2.08, 2.37) after controlling for ages of children and of housing.

## DISCUSSION

In agreement with previous studies, elevated blood lead levels were associated with living in older housing. Furthermore, we found a dose-response trend with higher blood lead levels and older housing by decade built. However, the steady trend of lower blood lead levels did not continue into the 1980s and 1990s, perhaps due to chance, alternative exposure sources, or screening bias. Houses built after 1978 are less likely to have leaded paint because leaded house paint was banned in 1978.<sup>4</sup>

Children living in lesser-valued houses were at greater risk of having elevated blood lead levels, suggesting that lesser-valued homes are more likely to have dilapidated paint. However, housing age does not indicate the condition of the paint or reflect recent remodeling that could increase a child's risk.<sup>5</sup> Therefore, for a given house age, a lesser-valued house is more likely to represent a lead exposure risk to children. Although low income is a known risk factor

for elevated blood lead levels, housing value intuitively appears to be a better marker of risk.

Our study had several limitations, including missing information on children's race/ethnicity and the source of lead exposure. Older houses may not have been the source of exposure if they had received lead abatement treatment or were in good condition. Information on alternative sources of exposure, such as parental occupation, nontraditional medicines, and folk remedies, was not available. House values from the tax assessor data might be incorrect. Finally, because we grouped houses built before 1900 into 1 category, those houses might require further stratified analysis.

The Centers for Disease Control and Prevention recommend targeted screening based on housing age, especially for houses built before 1950 or before 1978 with recent renovation.<sup>6</sup> Our results suggested that screening might be improved by considering the decade the house was built or the house's value. Geographic information systems technology can be used to link tax assessor information to better stratify children's risk and might be used further in strategic planning for lead screening, helping local programs identify high-risk areas to better target screening of children. ■

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## Contributors

Each author contributed to the planning of the study, the data acquisition and analysis, and the writing and editing of the paper.

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